

Biokey SDK 3.0 PRO Manual

Biokey SDK 3.0 PRO

Zhongkong Automation System Inc., Ltd

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1. Biokey Algorithm Description

Biokey algorithm is a kind of quick and accurate 1:1 and 1:N fingerprint identification algorithm, which is totally open to software developers and system integrators. If you use Biokey to identify fingerprints (2000-6000 pieces of fingerprints), you can complete the identification task easily within 1-5 seconds (the following tests require Pentium III 900MHz+ 128MB EMS memory) without categorizing fingerprints by names, PIN or any others in advance. Biokey algorithm has the following features:

- 1、 Biokey software development package can be quickly integrated to customers' systems, and can support any scanner device and fingerprint Sensor (Image quality ≥ 300 DPI) through open image process interface.
- 2、 By strainer mirrors and adequate valve values which are self-adaptive or can be easily matched, Biokey algorithm is able to weaken noise, increase the contrast degree of the bridge and vale, and even to capture whole or partial feature points from fingerprint of bad quality (fingerprint which is dirty, too dry or wet, broken, or with wounds, scars and marks) .
- 3、 Biokey algorithm identification supports the translation of fingerprints ($\geq 35\%$ of the fingerprint size) and circumrotation for 360 degree. Special technology is used to realize speedy verification when the fingerprint is translated or rotated for 360 degree (the average speed is 3000 pieces/second). Even when the fingerprint has few feature points (≤ 10 , normally fingerprint's feature

points ≥ 15), this function can also be achieved.

- 4、 Biokey algorithm does not require global feature points (core point, triangular point), and identification can be completed by local feature points.
- 5、 Through classification algorithm (fingerprints are classified into five categories: arch category, left loop category, right loop category, tine arch category, and vortex category), Biokey use global feature ordering in advance, which accelerates the process of fingerprint verification remarkably.
- 6、 Biokey algorithm is quite concise: data only need 350K memory, so that they can easily be imported into embedded systems.

Biokey was used to test 2000 pieces of fingerprints collected from four Sensors (YLC, DFR200, U.are.U, Authentec)—every piece of fingerprint was verified with the other ones, and verification and test were carried out for altogether 4,000,000 times—and eventually the following test results were achieved:

Template size	310 or 1152 Byte
Rotation	0 - 360 degree
FAR	$\leq 0.001\%$
FRR	$\leq 2.0\%$
Registration time	0.5 second
Average verification speed	2500 pieces/second
Image quality	$\geq 300\text{DPI}$

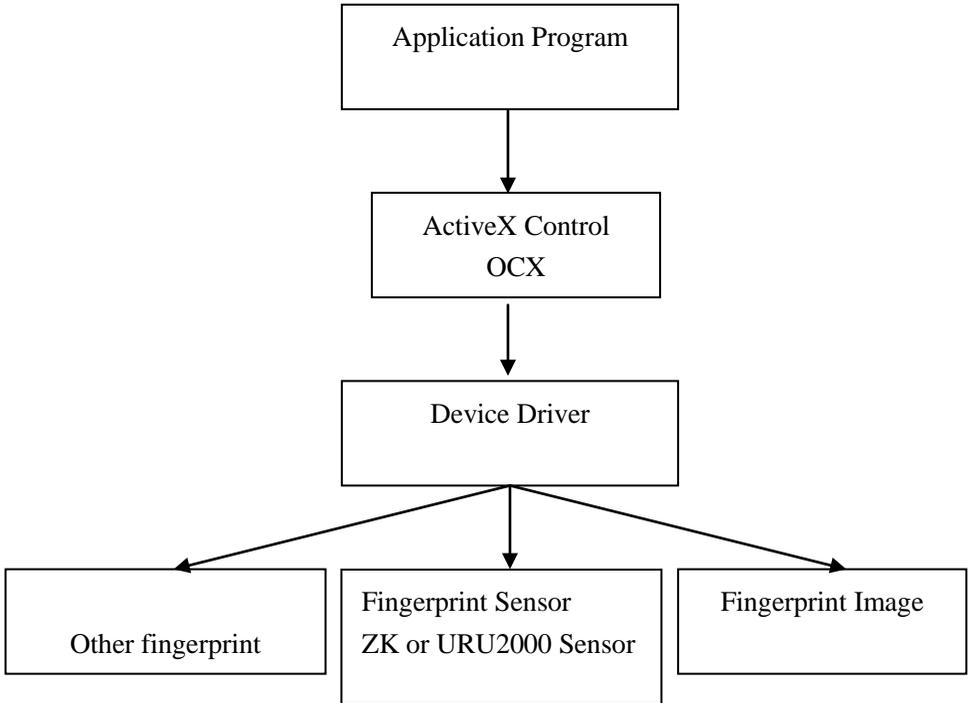
2. Biokey SDK Architect

Biokey SDK 3.0 Pro (Software Development Kit) mainly exists in the form of ActiveX, and users can develop application programs relative to fingerprint sensors by means of varied development languages (such as VC++, C++Builder, Delphi, VB, Visual Foxpro, PB and so on).

Files Included

Operation System	Files	Description
Windows 95(USB) Windows 98 Windows ME	Setup.exe	Installation program for fingerprint Sensor driver and Doggle driver
Windows NT Windows 2000	License.rtf	Development License Agreement
Windows XP	\Sdk\Manual.doc	Program Development Manual
	\Sdk\One\Biokey.ocx	Biokey 1:1 ActiveX Control
	\Sdk\Many\Biokey.ocx	Biokey 1:N ActiveX Control

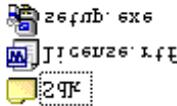
SDK Architecture



3. Software Installation

3.1 Disc Files and Directory

Open the Biokey SDK disc, and information about the directory and file will

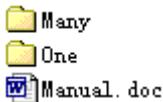


appear as the following:

Setup.exe: Installation program for fingerprint Reader driver and Doggle driver;

License.rtf: Development License Agreement.

Open the SDK directory, and the following directory and file information will be shown:

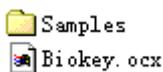


Manual.doc: SDK Instruction Manual;

Many: One-to-many identification development;

One: One-to-one identification development.

Open the One or Many directory, the following information about the



directory and files will be shown:

Samples: samples for various development languages;
Biokey.ocx: Control library files.

3.2 Software Installation

Before installing Biokey SDK, please make sure that your operation system and the configuration of your computer meet the requirements to run the software.

Before the installation, if your computer has been connected with a fingerprint Reader, you'd better pull it out.

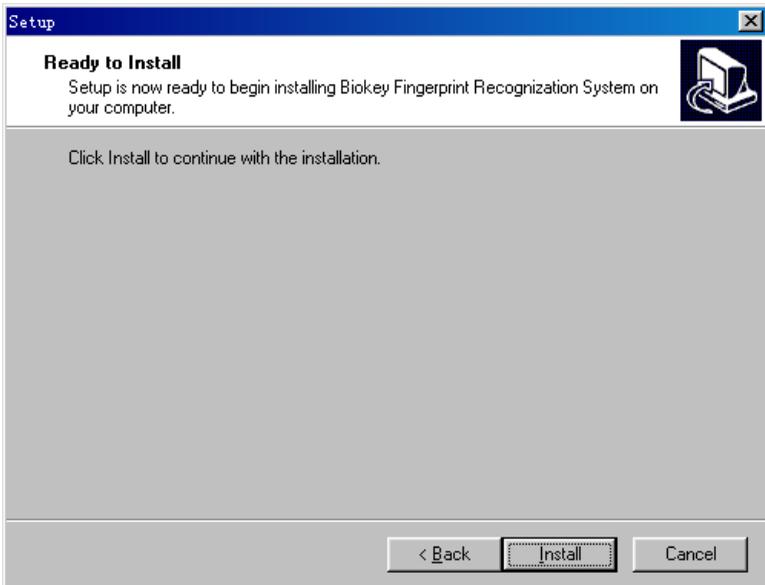
If URU 2.0x driver has been installed in your computer, please first uninstall it. In Windows98 system, the uninstalling process can be carried out by observing the following steps:

- a: Running 'Add/Delete' program on the control panel, so as to uninstall the fingerprint Reader's driver;
- b: Running *Registration Form* in 'Running' on Start menu, and deleting the key vale of
HKEY_LOCAL_MACHINE\Software\DigitalPersona ;
- c: Delete dl DP*.dll under the directory of Windows\system;
- d: Delete the whole directory of Program files\DigitalPersona.

1、 Put the installation disc in the driver, and the computer will automatically run the installation software. A window will pop out as the following:



Click Next button, and you can enter the following operation steps:



Press Installation button, and begin to install Fingerprint driver and Doggle driver.

2、 Copy the following file to Windows system directory (c:\windows\system):

Biokey.ocx Control Base File

3、 Register control Biokey.ocx:

c:\windows\system\regsvr32.exe c:\windows\system\biokey.ocx

Notice:

- 1) The installation program only installs fingerprint Reader driver and Doggle driver, and other development files should be copied by users to respective directories by hand;
- 2) By means of Doggle license, please make sure that Doggle is adequately connected to the parallel port on the computer;
- 3) By means of agreement file, it is needed to copy the agreement file to the current program execution directory or Windows system directory.

4、ActiveX Control Reference

Biokey SDK 3.0 Pro is divided into two controls: 1:1 and 1:N. For these two, their interfaces are basically of the same property and method, and the methods for the two interfaces only differ in the verification related to 1:N. In our further description, we will try to display the two controls comprehensively, and their differences will be labeled and illuminated.

VB language expression is used here, and fingerprint template Variant variable show as one-dimension byte arrays.

4.1 Property

4.1.1 Active as Boolean

Read only

Whether the fingerprint Reader set by the currentSensorIndex has got ready or not.

4.1.2 EngineValid as Boolean

Read only

Whether the fingerprint identification system is performing normally or not. If the function initEngine has been used, effective result will be returned.

4.1.3 EnrollIndex As Long

Read only

The sampling order number at fingerprint registration, that is, the effective times for successful fingerprint registration at present.

4.1.4 EnrollCount As Long

The times for sampling fingerprints at registration, whose value ranges from one to four.

4.1.5 FPEngineVersion AS String

read only

The version number for the fingerprint identification system.

4.1.6 ImageHeight AS integer

Read only

The height of the fingerprint image.

4.1.7 ImageWidth AS integer

Read only

The width of the fingerprint image.

4.1.8 IsRegister As Boolean

Read only

Whether a fingerprint is being registered or not.

4.1.9 OneToOneThreshold As Boolean

Set the identification threshold value (1-100) for Biokey low-speed fingerprint verification—one-to-one, and the default value is 10. The larger the value, the lower the FAR and the higher the FRR.

Notice: 1:1 control doesn't have this property.

4.1.10 RegTplFileName As String

Set to save the file name of the fingerprint registration template when the event OnEnrollToFile is taking place.

4.1.11 SensorCount As Long

Read only

The number of fingerprint Readers which are connected to the computer, and if EngineValid is invalid, 0 is returned.

4.1.12 SensorIndex AS Long

Select the order number of the fingerprint head when multiple fingerprint Readers are connected. The serial number starts from 0, and if the number is smaller than 0, the fingerprint Reader will not work.

4.1.13 SensorSN As String

The serial number for hardware of the fingerprint Reader.

4.1.14 TemplateLen As Long

Read only

The byte length of the fingerprint registration template.

Notice: The template length is 1152 bytes for 1:N, and the template length is 310 bytes for 1:1.

4.1.15 Threshold As Long

Set the verification and identification threshold value (1-100) for the fingerprint identification system, and the default value is 10. The larger the value, the lower the FAR and the higher the FRR.

4.1.16 VerTplFileName As String

Set to save the file name of the fingerprint verification template when the event OnCaptureToFile is taking place.

4.2 MethodS

The same method for the control interfaces of 1: 1 and 1:

N:

4.2.1 Sub BeginEnroll()

Begin to register fingerprints, and the event OnEnroll will take place when the registration completes.

4.2.2 Sub CancelEnroll()

Cancel the current status of fingerprint registration, that is, the operation started from BeginEnroll will be cancelled by this function.

4.2.3 Function DongleIsExist As Boolean

Examine whether Dongle is existing or not.

4.2.4 Function DongleSeed(Byval lp2 As Long, Byval p1, p2, p3, p4 As Integer) As Boolean

Obtain four 16-digital integral (p1, p2, p3, p4) return values for the seed code lp2. Dongle can compute a seed code by interior algorithm, which results in four return codes. Seed code algorithm is not open, and by examining whether the return codes are of the expected value we can examine whether Dongle is existing or not.

4.2.5 Function DongleUserID As Long

Read User ID in Dongle, and User ID will not repeat. Save it in specific location within Dongle.

4.2.6 Function DongleMemRead(Byval p1, p2 As Integer, buf) As Boolean

Read the p2 bytes started from p1 located in Doggle memory to Variant variable buf (one-dimension byte array). There are altogether 24 bytes in the memory, located from 0 to 23.

4.2.7 Function DongleMemWrite(Byval p1, p2 As Integer, buf) As Boolean

Write Variant variable buf (one-dimension byte array) to the p2 bytes started from p1 located in Doggle memory. There are altogether 24 bytes in the memory, located from 0 to 23.

4.2.8 Function GetTemplate()

Get the fingerprint template, which is obtained most recently.

4.2.9 Function GetFingerImage(Byval AFingerImage) As Boolean

Get the fingerprint image (BMP format), which is obtained most recently.

4.2.10 Function InitEngine() As Long

Initialize the fingerprint identification system. Property such as SensorCount, SensorSN, EngineValid, ImageHeight and ImageWidth will not return accurate results only after this function has been called. Return values:

0 Initialization succeeded.

1 The loading of the fingerprint identification driver failed.

2 Fingerprint Sensor has not been connected.

3 The fingerprint Reader appointed by the property SensorIndex dose not exist (Notice: Set the property SensorIndex before calling the function).

Method EndEngine can be used to release the fingerprint device system.

4.2. 11 Function VerFinger(byval regTemplate, verTemplate, AdoLearning As Boolean, byval AregFeatureChanged As Boolean) As Boolean

Compare whether the feature templates for two pieces of fingerprints are matched or not. Here, regTemplate represents fingerprint registration feature templates, verTemplate expresses fingerprint verification feature templates which are collected on the spot, AdoLearning denotes whether to carry out fingerprint feature template learning updating or not, and AregFeatureChanged shows whether the registration template regTemplate has been changed or not. True will be returned when the two pieces of fingerprints are matched, and False will be returned when not matched.

Explanation:

The fingerprint feature will vary to certain extent with the time, usually which will not pose an influence on the verification of fingerprints. While by fingerprint feature template learning updating, the system can obtain an integrated new template, so as to lower the FRR.

4.2.12 Function VerFingerFromFile(regTemplateFile As String, verTemplateFile As String , AdoLearning As Boolean, byval AregFeatureChanged As Boolean) As Boolean

Compare whether the feature templates for two pieces of fingerprints are matched or not. Here, regTemplate represents fingerprint registration feature templates, verTemplate expresses fingerprint verification feature templates which are collected on the spot, AdoLearning denotes whether to carry out fingerprint feature template learning updating or not, and AregFeatureChanged shows whether the registration template regTemplate has been changed or not. True will be returned when the two pieces of fingerprints are matched, and False will be returned when not matched.

4.2.13 Function VerRegFingerFile(RegTemplateFile As String, verTemplate, AdoLearning As Boolean, byval AregFeatureChanged As Boolean) As Boolean

Compare whether the feature templates for two pieces of fingerprints are matched or not. Here, regTemplate represents previous fingerprint registration feature templates in the file specified by FileName, verTemplate expresses fingerprint feature templates which are collected on the spot, AdoLearning denotes whether to carry out fingerprint feature template learning updating or not, and AregFeatureChanged shows whether the registration template regTemplate has been changed or not. True will be returned when the two pieces of fingerprints are matched, and False will be returned when not matched.

4.2.14 Sub PrintImageAt(HDC As OLE_HANDLE, X As Long, Y As Long, aWidth As Long, aHeight As Long)

At the location specified by (x,y), display the fingerprint image in accordance with the size specified by (aWidth, aHeight). HDC is the HDC for the window in which the fingerprint will be shown.

4.2.15 Sub PrintImageEllipseAt(HDC As OLE_HANDLE, X As Long, Y As Long, aWidth As Long, aHeight As Long, bkColor As OLE_COLOR)

At the location specified by (x,y), display the fingerprint image in accordance with the size specified by (aWidth, aHeight). HDC is the HDC for the window in which the fingerprint will be shown. Here the fingerprint image is surrounded by an ellipse.

4.2.16 Sub SaveBitmap(FileName As String)

Save the last fingerprint image to the bitmap file specified by FileName.

4.2.17 Sub SaveJPG(FileName As String)

Save the last fingerprint image to the Jpeg file specified by FileName.

4.2.18 Function SaveTemplate(FileName As String, Template) As Boolean

Save the feature template for the Template fingerprint to the file specified by FileName.

4.2.19 function EncodeTemplate(ASour, var ADest As String) As Boolean

Transfer the Variant template ASour used by the control into the template string Adest, which is BASE64 formatted.

4.2.20 function DecodeTemplate(const ASour As String, ADest) As Boolean

Transfer the template string ASour which is BASE64 formatted into the Variant-typed template ASour used by the control.

The above-mentioned two methods are mainly used for saving database of templates. Variant-typed templates are saved in the manner of binary-formatted arrays, which are quite difficult for languages such as PB, VB, etc. Method EncodeTemplate can transfer Variant-typed codes into strings, and method DecodeTemplate can transfer string-typed codes into codes of Variant-typed. Here, we should pay attention that the template length will be increased after the template variable BASE64 code has been transferred into the string.

4.2.19 function EncodeTemplate1(ASour) As String

Transfer the Variant template ASour used by the control into the template string, which is BASE64 formatted.

4.2.20 function DecodeTemplate1(const ASour As String) As Variant

Transfer the template string ASour which is BASE64 formatted into the Variant-typed template used by the control.

4.2.21 Sub BeginCapture()

Set the current fingerprint device to begin to capture images, and method CancelCapture can be used to forbid the current device to capture images.

4.2.22 Sub EndEngine()

Release the fingerprint device initialized by method InitEngine, and method InitEngine can be utilized to re-initialize fingerprint device.

Method for 1:N control interface:

4.2.23 Function AddRegTemplateToFPCacheDB(fpcHandle As Long, FPID As Long, pRegTemplate) As Long

Add the fingerprint registration template pRegTemplate to the fingerprint sensor's high-speed buffer fpcHandle, and FPID is the label for adding registration template.

4.2.24 Function AddRegTemplateFileToFPCacheDB(fpcHandle As Long, FPID As Long, pRegTemplateFile As String) As Long

Add the previous fingerprint registration feature template in the file specified by pRegTemplateFile to the fingerprint identification high-speed buffer fpcHandle, and FPID, which must be equal to or larger than 0, is the label for adding the registration template. If the return value is 1, it indicates a success, and 0 indicates a failure.

4.2.25 Function CreateFPCacheDB As Long

Create the fingerprint identification high-speed buffer. As for 1:N identification, this function must be first called so as to obtain the fingerprint identification buffer handle.

Explanation:

Biokey 1:1 low-speed verification speed is rather slow (about 30ms for PII 233), so fingerprints of 1:1 genre added to the buffer by calling the function AddRegTemplateToFPCache can not be too many; otherwise, the verification speed will be impacted. By IsOneToOneTemplate, we can judge whether the fingerprint is of 1: 1 type or not.

At the same time multiple buffers can be created for group comparison and others.

4.2.26 Sub FlushFPImages ()

Delete buffer images in the current fingerprint device.

4.2.27 Sub FreeFPCacheDB(fpcHandle As Long)

Release the fingerprint identification high-speed buffer. FpcHandle is the fingerprint identification buffer handle obtained by calling the function CreateFPCacheDB.

4.2.28 Function IdentificationFromFileInFPCacheDB (fpcHandle As Long, pVerTemplateFile As String, Byval Score As Long, Byval ProcessedFPNumber As Long) As Long

Compare all the registration templates in the fingerprint verification template file pVerTemplateFile and the fingerprint identification high-speed buffer fpcHandle. Score represents the highest score among ProcessedFPNumber times of verification, and ProcessedFPNumber shows the times of verification. The fingerprint label will be returned if the identification is successful, and -1 is returned if failed.

Notice:

During the process of identification, if the verification score is equal to or larger than the property Threshold, then it is considered that the verification is successful. In this case, no further verification will be carried out for the rest of

fingerprint registration templates in the buffer, and this function returns the fingerprint label for the fingerprint registration template which is matched successfully;

If all the scores for the verification between all the fingerprint verification templates and all the fingerprint identification templates located in the fingerprint identification high-speed buffer, but meanwhile the highest score for the verification is equal to or larger than Score, then it is viewed that the verification is matched successfully. In this case, this function will return the label of the fingerprint registration template which gets the highest verification score, whose recommendation value is 9.

4.2.29 Function IdentificationInFPCacheDB (fpcHandle As Long, pVerTemplate, Byval Score As Long, Byval ProcessedFPNumber As Long) As Long

Compare all the registration templates in the fingerprint verification template file pVerTemplateFile and the fingerprint identification high-speed buffer fpcHandle. Score represents the highest score among ProcessedFPNumber times of verification, and ProcessedFPNumber shows the times of verification. The fingerprint label will be returned if the identification is successful, and -1 is returned if failed.

Notice:

During the process of identification, if the verification score is equal to or larger than the property Threshold, then it is considered that the verification is successful. In this case, no further verification will be carried out for the rest of fingerprint registration templates in the buffer, and this function returns the fingerprint label for the fingerprint registration template which is matched successfully;

If all the scores for the verification between all the fingerprint verification

templates and all the fingerprint identification templates located in the fingerprint identification high-speed buffer, but meanwhile the highest score for the verification is equal to or larger than Score, then it is viewed that the verification is matched successfully. In this case, this function will return the label of the fingerprint registration template which gets the highest verification score, whose recommendation value is 9.

4.2.30 Function IsOneToOneTemplate (ATemplate) As Boolean

Judge the current fingerprint feature template Atemplate is a Biokey 1:1 low-speed verification feature template.

4.2.31 Function ModifyTemplate(byval Atemplate, AOneToOne As Boolean) As Boolean

According AoneToOne modify the fingerprint feature template Atemplate to a Biokey 1:1 low-speed verification feature template or a high-speed verification feature template.

4.2.32 Function RemoveRegTemplateFromFPCacheDB (fpcHandle As Long, FPID As Long) As Long

Delete the fingerprint registration template which is labeled as FPID located in the fingerprint identification high-speed buffer fpcHandle. If the return value is 1, it indicates a success, and 0 represents a failure.

4.2.33 Sub CancelCapture()

Forbid the current fingerprint device to capture images, and the method BeginCapture can be used for the fingerprint device to begin to capture images.

Methods for 1:1 control interface:

4.2.34 Function AddBitmap(BitmapHandle As OLE_HANDLE, ValidRectX1 As Long, ValidRectY1 As Long, ValidRectX2 As Long, ValidRectY2 As Long, DPI As Long) As Boolean

Use the bitmap specified by BitmapHandle for registration or verification. These four parameters, ValidRectX1、ValidRectY1、ValidRectX2、ValidRectY2 define the effective area for the image. If the defined image area is invalid, then the whole targeted image will be captured, and DPI defines the resolution of the image.

4.2.35 Function AddImageFile(FileName As String, DPI As Long) As Boolean

Use the fingerprint image file (supporting such formats as BMP,TIFF,JPG,GIF) specified by FileName for registration or verification. DPI defines the resolution of the image.

4.3 Events

4.3.1 OnCapture(ActionResult AS Boolean, ATemplate)

Capture the fingerprint verification template Atemplate for verification. ActionResult =true indicates that the fingerprint template is obtained successfully, and False represents a failure.

4.3.2 OnCaptureToFile(ActionResult AS Boolean)

Obtain the fingerprint verification template for verification, and the template is saved in a file, whose name is set by the property VerTplFileName. ActionResult =true indicates that the fingerprint template is obtained successfully, and False represents a failure.

4.3.3 OnEnroll(ActionResult AS Boolean, ATemplate)

Call this even when the user fingerprint registration completes. ActionResult =true indicates that the registration is successful, and the fingerprint feature template can be captured by using pTemplate property; False represents a failure.

4.3.4 OnEnrollToFile(ActionResult AS Boolean)

Call this event when the user fingerprint registration completes. ActionResult =true indicates that the registration is successful, and the fingerprint feature template is saved in a file, whose name is set as the property RegTplFileName; False represents a failure.

4.3.5 OnFeatureInfo(AQuality As Long)

Obtain the fingerprint's initial feature. Quality represents the quality of this fingerprint's feature, and it may have the following values:

0: Good fingerprint feature

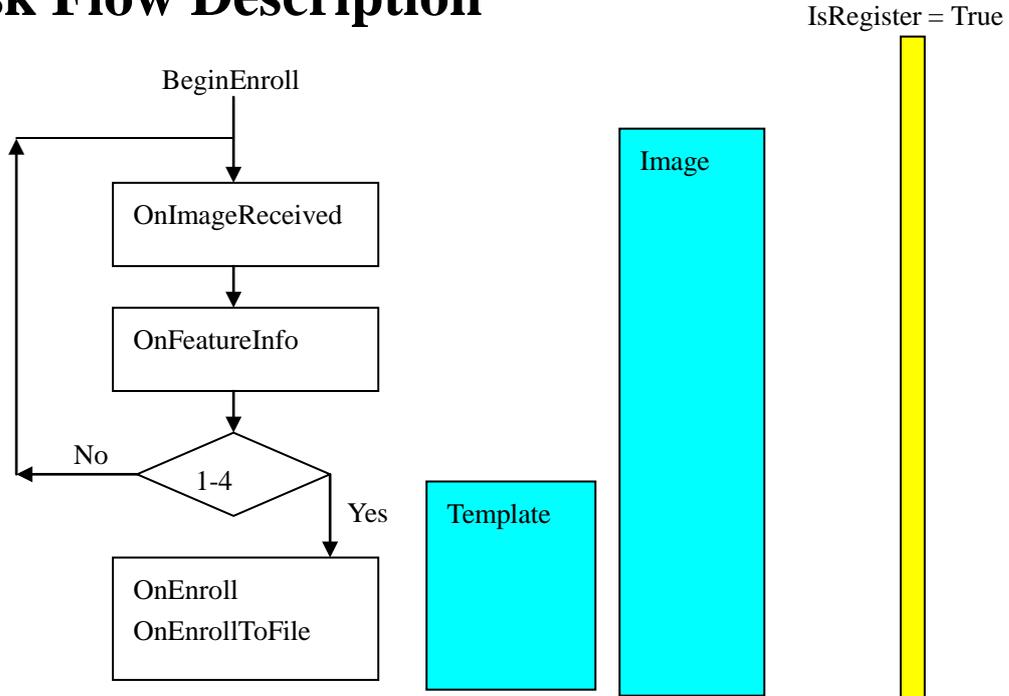
1: Insufficient feature points

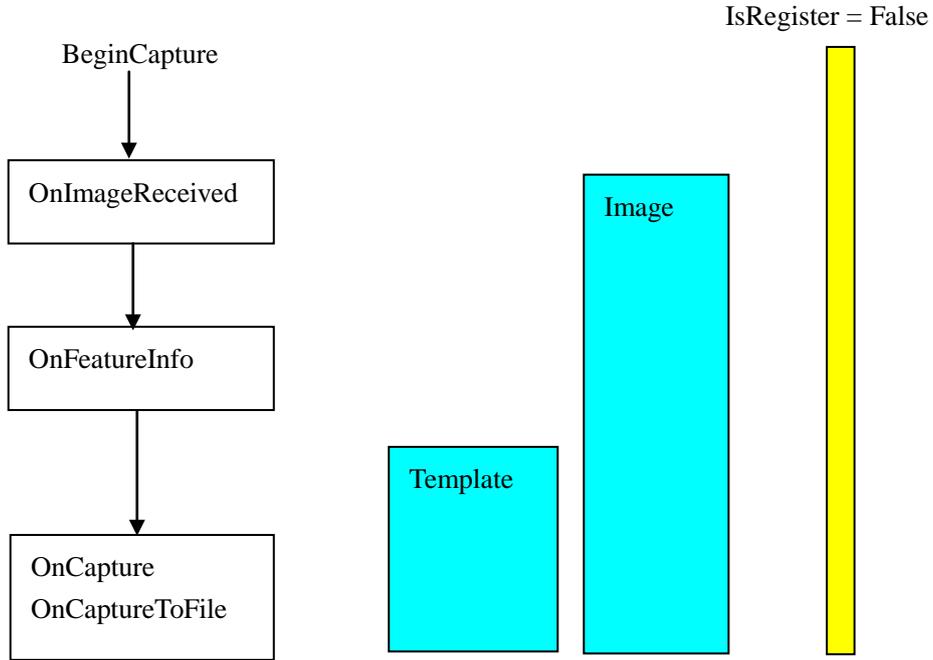
2: Other reasons resulting in the incapability to capture the fingerprint feature

4.3.6 OnImageReceived(byval AImageValid As Boolean)

Call this event if the device receives the fingerprint image, or the fingerprint image is added by AddImageFile and AddBitmap. AImageValid indicates whether to extract a template or not. If it is set as False, the system will not extract templates after it has captured the fingerprint image.

5、Task Flow Description





Task Flow Description:

After the fingerprint Sensor has entered the working status, call `BeginEnroll` to enter fingerprint registration status, and call `BeginCapture` to enter fingerprint verification status. The working mode is based on event motivation, and events can be triggered in an order as shown in the above sketch graph.

It is usually needed to press the same finger for 1 to 4 times for fingerprint registration, and a fingerprint registration template will be obtained after the identification system integrates them. The times number needed for pressing the finger at registration is defined by the control property `EnrollCount`, and events `OnEnroll` and `OnEnrollToFile` will be triggered if the defined times number is arrived at.

At fingerprint verification, events `OnCapture` and `OnCaptureToFile` will be triggered after pressing the finger. At this moment, `VerFinger` or `IdentificationInFPCacheDB` can be called to carry out 1:1 or 1:N verification.

It should be paid attention to that event `OnFeatureInfo` will be triggered when a finger is being pressed for each time. If the fingerprint template of the finger which is being pressed, is not qualified, this time the image captured is invalid, and the finger should be re-pressed.

6、 Common Questions Description

6.1 The difference between 1:1 Control and 1:N Control

1: 1 Control is mainly used for development projects which need 1:1 verification, and usually the currently-verified client's PIN should be entered in advance, and after that one or several templates he/she has registered are obtained for verification; while 1:N Control does not require entering the client's PIN, and this client can be identified by the client's fingerprint out of the registered fingerprint templates.

1:1 Control mainly aims to achieve a high pass rate and a relatively high accuracy rate; 1:N Control is principally designed to obtain a high verification speed and a relatively high accuracy rate.

1: 1 Control's maximum template length is only 310 bytes, while that for 1:N Control is 1152 bytes. Because 1:N requires high-speed verification, and a remarkably low RAR, relatively more template feature information should be saved.

6.2 Read-in and Read-out Fingerprint Templates in Database

In SDK fingerprint templates are saved and called by means of Variant variable. What is stored is one-dimension binary arrays, which can not be read-in

and read-out by SQL sentences as for character strings. There are two solutions:

- 1、 Method EncodeTemplate and method DecodeTemplate are able to make BASE64 code transfer between Variant variables and string variables. One point, which should be improved, is that after variables being transferred into strings, the template length will be increased by about 1/3.
- 2、 Directly work on Variant variables. An example is shown as the following:
Delphi, CB:

```
procedure TFPPProcess.SaveFPData(AQuery: TADOQuery; AFingerID: Integer; AFPData:
OleVariant);
var
  pData: PChar;
begin
  with AQuery do begin
    Close;
    SQL.Clear;
    SQL.Add('SELECT * FROM zkFingerPrint WHERE FingerID = ' + IntToStr(AFingerID));
    Open;
    if IsEmpty then
      Append
    else
      Edit;
    FieldByName('FingerID').Value := AFingerID;
    //Save the fingerprint template
    with TBlobStream(CreateBlobStream(FieldByName('Template'), bmWrite)) do begin
      pData := VarArrayLock(AFPData);
      try
        Write(pData^, VarArrayHighBound(AFPData, 1) - VarArrayLowBound(AFPData, 1) + 1);
      finally
        VarArrayUnlock(AFPData);
      end;
    end;
```

```
    Free;
end;
Post;
Close;
end;
end;
procedure TFPPProcess.GetFPData(AQuery: TADOQuery; AFingerID: Integer; var AFPData:
OleVariant);
var
    pData: PChar;
begin
    with AQuery do begin
        Close;
        SQL.Clear;
        SQL.Add('SELECT * FROM zkFingerPrint WHERE FingerID = ' + IntToStr(AFingerID));
        Open;
        //read-out data
        if not IsEmpty then
            with TBlobStream(CreateBlobStream(FieldByName('Template'), bmRead)) do begin
                AFPData := VarArrayCreate([0, Size + 1], varByte);
                pData := VarArrayLock(AFPData);
                try
                    Read(pData^, Size);
                finally
                    VarArrayUnlock(AFPData);
                end;
                Free;
            end;
        Close;
    end;
end;
```

end;

For other languages, please refer to the technical discussion forum on www.zksoftware.com.

6.3 Software Doggle and Authorized License Documentation

The running of SDK requires software Doggle and authorized license documentation. The difference between software Doggle and authorized license documentation is that software Doggle is independent of the fingerprint Sensor which is being used, while authorized license documentation corresponds to the fingerprint Sensor which is being used. That is, software Doggle can be used with all fingerprint Sensors, but authorized license documentation can only be used with the authorized fingerprint Sensor.

6.4 The use of 1:N high-speed buffer

For 1:N verification, it is needed to categorize the templates to be verified; at the same time, in order to achieve higher speed, SDK needs to create memory first, and then add registered fingerprints to the memory. In fact, high-speed buffer is a kind of memory. In practice, firstly we need to create the buffer by the method `CreateFPCahceDB`, and then by methods such as, `AddRegTemplateToFPCahceDB`, `RemoveRegTemplateFromFPCacheDB` and so on, to add or delete fingerprint registration templates, and lastly free the memory by the method `FreeFPCacheDB`.

We can create multiple high-speed buffers at the same time so as to realize such functions as grouping query.

6.5 Using fingerprint images

In projects where 1:1 Control is used, quite often you are required to save fingerprint images, or to obtain plane fingerprint images directly from scanning. Thus, 1:1 Control SDK provides methods, which are capable of capturing fingerprint registration templates directly from plane fingerprint images, such as `AddImageFile`. But what should be paid attention to is that images should be captured correctly, and their resolution must not be less than 350DPI.

Notice: SDK in normal versions dose not provide these methods.

6.6 Setting fingerprint identification threshold

In 1:1 Control, the recommendation value for the property `Threshold` is 10. In this case, FAR is about 0.01%, and FRR ranges from 1.5% to 2%.

In 1:1 Control, the recommendation value for the property `Threshold` is 10. In this case, FAR is about 0.001%, FRR is about 3%, and the recommendation value for the property `OneToOneThreshold` is 10.

6.7 Solutions to low-quality fingerprint templates for 1:N identification

In 1:N Control, at fingerprint registration, the system will automatically label fingerprints by categories in terms of quality, and save them in templates. Templates of low quality are titled as Biokey 1:1 low-speed verification feature templates, and 1:1 in this term is a concept quite different from 1:1 in 1:1 Control,

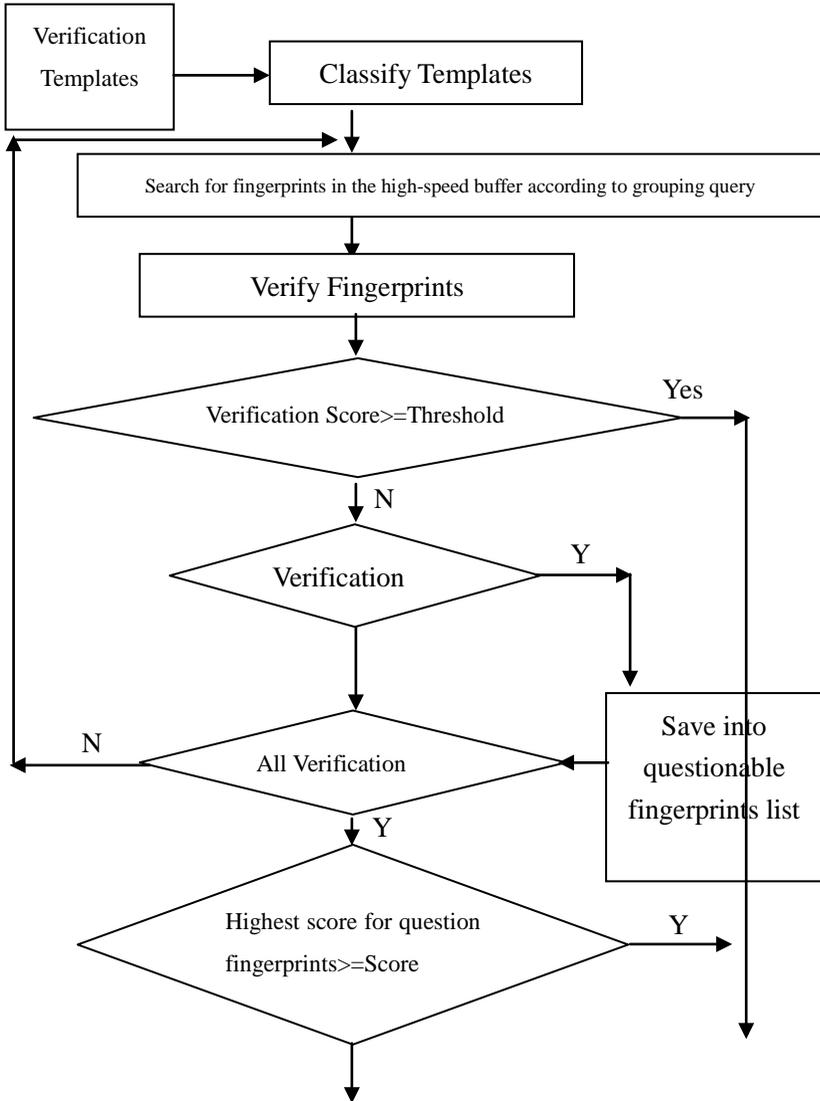
which should not be mixed up. Registration templates of high quality are labeled as Biokey high-speed verification feature templates.

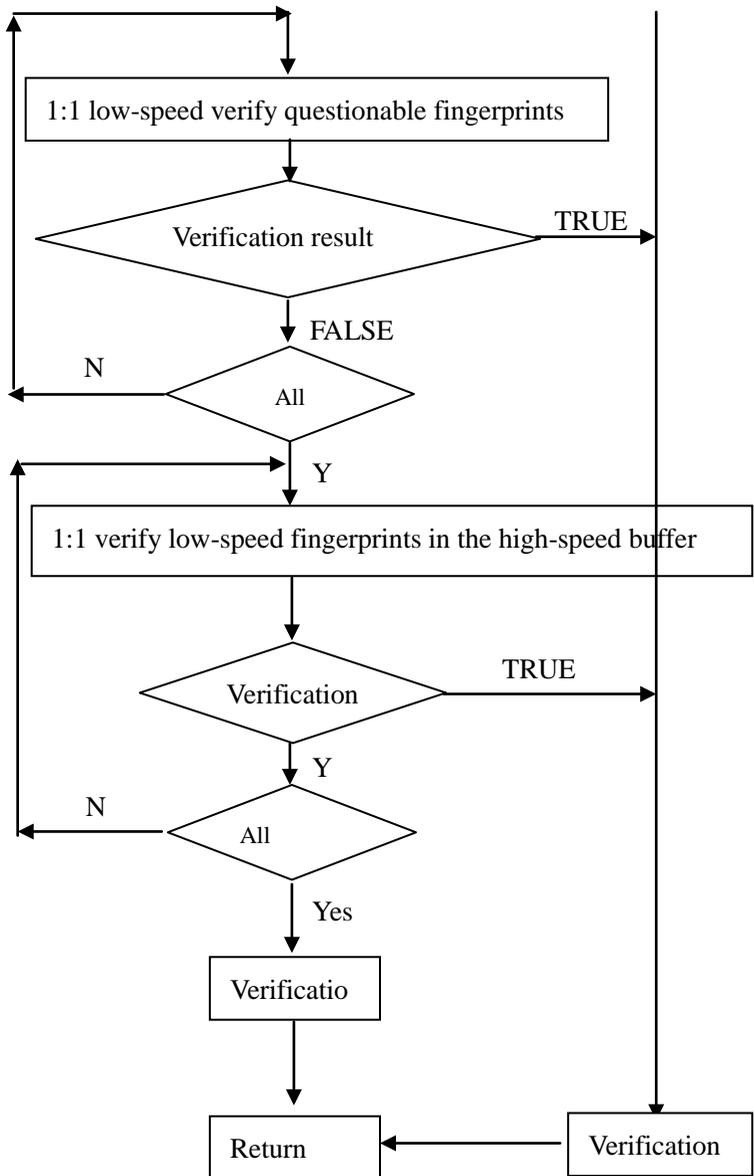
In normal application environments, about 5% of the total fingerprint registration templates will be labeled as low-speed verification feature templates. The method `IsOneToOneTemplate` can be used to judge whether the template is a low-speed verification feature template, and the method `ModifyTemplate` can be used to modify grouping labels which distinguish templates of high quality from those of low quality forcefully.

Biokey 1:1 low-speed verification is quite slow (about 30ms for PII 233), thus not too many low-speed verification feature templates can be added to the high-speed buffer by the method `AddRegTemplateToFPCache`; otherwise the verification speed will be impacted.

In 1:N Control, fingerprint identification by `IdentificationInFPCacheDB` is carried out in the way as shown in the following flow chart:

IdentificationFromFileInFPCacheDB (fpcHandle As Long, pVerTemplateFile As String, Byval Score As Long, Byval ProcessedFPNumber As Long) As Long





6.8 Connecting multiple fingerprint Sensors

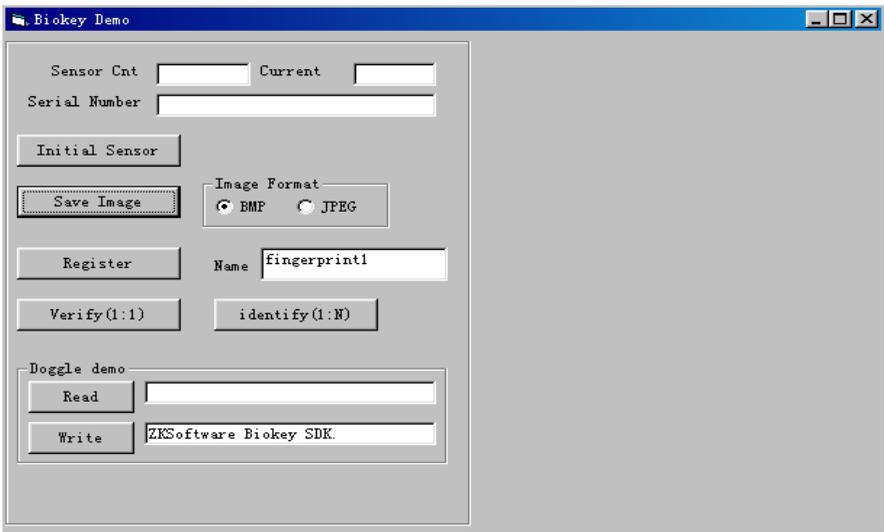
In the window one control responds to one fingerprint Sensor. Different fingerprint Sensors can be set by using `SensorIndex`, and the number of fingerprint Sensors can be obtained by the property `SensorCount`. If you want to differentiate the fingerprint Sensors from each other, utilize the property `SensorSN`, which is unique for each fingerprint Sensor.

7、 DEMO Program Description

Here VB sample program of 1:N Control is used for description (which is similar to that of 1:1 Control).

At first it must be confirmed that 1:N Control has been registered, Doggle has been plugged into the parallel port or authorized documentation has been copied to the path of the current application program, and the fingerprint Sensor driver has been installed.

Run Demo in VB, and the following form will appear:



The name of the window fingerprint control is ZKFPEngX1.

At first, press Initialize button to initialize the fingerprint Sensor. If the initialization is successful, a prompt message which indicates a success will be shown.

The initialization code is as the following:

```
If ZKFPEngX1.InitEngine = 0 Then
    MessageBox 0, "Initialization succeeds! ", "Prompt message", 0

    StatusBar.Caption = "Fingerprint Sensor connection"
    TextSensorCount.Text = ZKFPEngX1.SensorCount & ""
    TextSensorIndex.Text = ZKFPEngX1.SensorIndex & ""
    TextSensorSN.Text = ZKFPEngX1.SensorSN

    cmdInit.Enabled = False
    FMatchType = 0
End If
```

Press the Register Fingerprint button to enter the fingerprint registration status, and the code is like the this:

```
If Trim(TextFingerName.Text) = "" Then
    MessageBox 0, "Please enter the fingerprint name label! ", "False", 0
    Exit Sub
End If
ZKFPEngX1.BeginEnroll
StatusBar.Caption = "Start registration"
```

At this moment, the fingerprint Sensor is under the status of registration, and every time pressing a finger will trigger events OnImageReceived (display images), and OnFeatureInfo (judge whether the fingerprint is qualified or not) .

Pressing a finger for one or four effective times (not counting times if the finger is unqualified) will trigger events OnEnroll and OnEnrollToFile, and the specific pressing times number is set by the property EnrollCount. OnEnroll code is like this :

Dim i As Long

If Not ActionResult Then

 MessageBox 0, "Fingerprint registration failed! ", "Warning", 0

Else

 MessageBox 0, "Fingerprint registration succeeded!", "Message", 0

 FRegTemplate = ATemplate

 ZKFPEngX1.SaveTemplate "c:\fingerprint.tpl", ATemplate

 ZKFPEngX1.AddRegTemplateFileToFPCacheDB fpcHandle, FingerCount, "c:\fingerprint.tpl"

 ReDim Preserve FFingerNames(FingerCount + 1)

 FFingerNames(FingerCount) = TextFingerName.Text

 FingerCount = FingerCount + 1

End If

Parameter ActionResult=True indicates successful registration, and parameter Atemplate represents the fingerprint registration template; otherwise the registration failed.

Press the button Verify Fingerprint to enter the status of fingerprint verification, and the fingerprint Sensor will be under the status of verification. Pressing a finger will trigger events OnImageReceived (display images) and OnFeatureInfo (judge whether the finger is qualified or not) , and a qualified fingerprint will trigger events OnCapture and OnCaptureToFile (verify by the verification method) .

OnCapture code is like this:

```
Dim fi As Long, i As Long
Dim Score As Long, ProcessNum As Long
Dim RegChanged As Boolean
```

```
StatusBar.Caption = "capture fingerprint feature"
```

```
If FMatchType = 1 Then '1:1
```

```
    If ZKFPEngX1.VerFinger(FRegTemplate, ATemplate, False, RegChanged)
```

```
Then
```

```
    MessageBox 0, "Fingerprint verification succeeded! ", "Prompt
message", 0
```

```
    Else
```

```
        MessageBox 0, "Fingerprint verification failed! ", "Prompt message", 0
```

```
    End If
```

```
    'If ZKFPEngX1.VerRegFingerFile("c:\fingerprint.tpl", ATemplate) Then
```

```
        '    MessageBox 0, "File fingerprint verification succeeded! ", "Prompt
message", 0
```

```
        'Else
```

```
            '    MessageBox 0, "File fingerprint verification failed! ", "Prompt
message", 0
```

```
        'End If
```

```
    ElseIf FMatchType = 2 Then '1:N
```

```
        Score = 8
```

```
        fi = ZKFPEngX1.IdentificationInFPCacheDB(fpcHandle, ATemplate, Score,
ProcessNum)
```

```
        If fi = -1 Then
```

```
            MessageBox 0, "Fingerprint verification failed! ", "Prompt message", 0
```

```
        Else
```

```
            MessageBox 0, "Fingerprint verification succeeded ! Name=" &
```

```

FFingerNames(fi) & " Score = " & Score & " Processed Number = " &
ProcessNum, "Prompt information", 0
    End If
End If

```

OnImageReceived event code (display fingerprint images):

```

ZKFPengX1.PrintImageAt hDC, FrameCommands.Width + 6,
FrameCommands.Top, ZKFPengX1.ImageWidth, ZKFPengX1.ImageHeight

```

OnFeatureInfo event code (judge fingerprint quality):

```

Dim sTemp As String
sTemp = ""
If ZKFPengX1.IsRegister Then
    sTemp = "registration status: press again" & ZKFPengX1.EnrollIndex &
"time fingerprint!"
End If
sTemp = sTemp & " fingerprint quality"
If AQuality <> 0 Then
    sTemp = sTemp & "Unqualified: " & AQuality
Else
    sTemp = sTemp & "Qualified"
End If
StatusBar.Caption = sTemp

```

Press Doggle Read Memory button, and the control's version information will be shown in the corresponding edition box; if no information is shown, it means that Doggle has not been plugged in, or the driver has not been installed.

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E-mail: support@biometric.com.cn

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